

AMENDMENTS TO THE CLAIMS

1. (Currently amended) A liquid crystal display (LCD) comprising:

5 a first substrate comprising a first surface;
 a second substrate comprising a second surface, the second surface being in parallel with and opposite to the first surface of the first substrate, and a pixel area being defined on the second surface;

10 a first common electrode positioned on the first surface of the first substrate;
 a secondpixel electrode disposed above the pixel region of the second substrate, the second electrode having a first slit elongated along a first direction;

15 an isolation layer disposed on the surface of the second substrate to cover the secondpixel electrode;
 a ~~third~~second common electrode disposed on the isolation layer and within the pixel region, a second slit being defined on the ~~third~~second common electrode and along the first direction, the first and second slits being interlaced; and

20 a plurality of anisotropic liquid crystal molecules with negative dielectric constant positioned between the first common electrode and the ~~third~~second common electrode, the longitudinal axis of the liquid crystal

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molecules being positioned along a second direction horizontally, and a first angle being formed between the first direction and the second direction; wherein a biased electric field is formed as a voltage is applied between the first common electrode and the second pixel electrode,

such that (a) a first horizontal biased electric field is formed in the neighborhood of the second slit, the first horizontal biased electric field is perpendicular to the first direction, and the liquid crystal molecules are rotated to make the longitudinal axis of the liquid crystal molecules in the neighborhood of the second slit being in parallel to the first direction,

(b) the longitudinal axis of the liquid crystal molecules in the neighborhood of the first common electrode maintain along the second direction because no horizontal biased electrical field is formed near the first common electrode, and

(c) the liquid crystal molecules between the first common electrode and the second slit of the ~~third~~second common electrode gradually rotate from the second direction to the first direction.

2. (Original) The liquid crystal display of claim 1, further comprising a first polarizer positioned above the first substrate, and a second polarizer positioned below the second substrate.

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3. (Canceled)

4. (Currently amended) The liquid crystal display of claim 1 wherein the ~~third~~^{second} common electrode is a transparent lower common electrode.

5. (Currently amended) The liquid crystal display of claim 1 wherein the biased electric field formed between the ~~second~~^{pixel} electrode and the ~~third~~^{second} common electrode is used to accelerate the rotation of the liquid crystal molecules so as to reduce a driving voltage of the liquid crystal display.

6. (Currently amended) The liquid crystal display of claim 1 wherein the isolation layer is used to isolate the ~~second~~^{pixel} electrode from the ~~third~~^{second} common electrode and avoid a short circuit between the ~~second~~^{pixel} electrode and the ~~third~~^{second} common electrode.

7. (Currently amended) The liquid crystal display of claim 1 further comprising a protrusion projected from the first surface of the first substrate, the protrusion being electrically connecting the first common electrode with the 5 ~~third~~second common electrode so that the first common electrode and the ~~third~~second common electrode being in a substantially equal voltage.

8.(Currently amended) The liquid crystal display of claim 7 10 wherein a common signal is provided to the first common electrode and ~~third~~the second common electrodes, the first common electrode is connected to the ~~third~~second common electrode so as to reduce a delay of the common signal.

15 9. (Currently amended) The liquid crystal display of claim 7 wherein the ~~third~~second common electrode has a width, and the width is reduced when the first common electrode is connected to the ~~third~~second common electrode so as to increase an aperture ratio of the display.

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10. (Currently amended) The liquid crystal display of claim 7 wherein static charges formed on the first common electrode are released through the protrusion after the first common electrode is connected to the ~~third~~second common electrode.

11. (Original) The liquid crystal display of claim 7 wherein
the distance between the first and second substrate is defined
as a cell gap, and the protrusion is used to form an even cell
5 gap between the first and second substrates.

REMARKS

Claims 1,2,5, and 6 are rejected under 35 U.S.C. 102(e) as being anticipated by Matsuyama et al (Matsuyama) USPAT 6,469,765. Claims 3 and 4 are 5 rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuyama in view of Sato USPAT 6,160,601. Claims 7-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuyama in view of Tani USPAT 6,392,735. Response to the Office Action identified 10 above is listed below.

1. Rejection of Claims 1,2,5, and 6 under 35 U.S.C. 102(a):

As to claim 1, Matsuyama discloses in Figures 9 and 10, third embodiment (col.21, line 36 through col.22, 15 line 55), a liquid crystal display (LCD) comprising: a first substrate, 900, comprising a first surface; a second substrate, 800, comprising a second surface, the second surface being in parallel with and opposite to the first surface of the first substrate, and a pixel 20 area being defined on the second surface; a second common electrode, 500 (Applicant's first electrode), positioned on the first surface of the first substrate; a first common electrode, 410 (Applicant's second electrode), disposed above the pixel region of the 25 second substrate; the second electrode having side opening portions, 416 (Applicant's first slit) elongated along a first direction; an isolation layer, 812, disposed on the surface of the second substrate to cover the second electrode; a pixel electrode, 300 (Applicant's third electrode), disposed on the isolation layer and within the pixel region, opening portions, 304 (Applicant's second slit), being defined 30

on the third electrode and along the first direction, the first and second slits being interlaced (per Figures 9 and 10); and a plurality of anisotropic liquid crystal molecules with negative dielectric constant (Abstract) positioned between the first electrode and the third electrode, the longitudinal axis of the liquid crystal molecules being positioned along a second direction horizontally (Figure 3 and col.21, lines 42-45), and a first angle being formed 5 between the first direction and the second direction; wherein a biased electric field is formed as a voltage is applied between the first electrode and the second electrode, such that (a) a first horizontal biased electric field is formed in the neighborhood of the 10 second slit (Figure 4), the first horizontal biased electric field is perpendicular to the first direction, and the liquid crystal molecules are rotated to make the longitudinal axis of the liquid crystal molecules in the neighborhood of the second slit being in 15 parallel to the first direction, (b) the longitudinal axis of the liquid crystal molecules in the neighborhood of the first electrode maintain along the second direction because no horizontal biased electric field is formed near the first electrode, and (c) the 20 liquid crystal molecules between the first electrode and the second slit of the third electrode gradually rotate from the second direction to the first direction.

30 As to claim 2, Matsuyama discloses the liquid crystal display of claim 1, further comprising a first polarizer, 910, positioned above the first substrate,

and a second polarizer, 810, positioned below the second substrate (col.14, lines 58-65 and col.21, lines 42-45).

5 As to claim 5, the recitation of: wherein the biased electric field formed between the second electrode and the third electrode is used to accelerate the rotation of the liquid crystal molecules so as to reduce a driving voltage of the liquid crystal display, is an intended use and/or performance recitation in a device claim that is considered inherently met by the structure of Matsuyama.

As to claim 6, the recitations of: wherein the isolation layer is used to isolate the second electrode from the third electrode and avoid a short circuit between the second electrode and the third electrode, is an intended use and/or performance recitation in a device claim that is considered inherently met by the structure of Matsuyama.

Response:

First, claim 1 is amended in the above AMENDMENTS TO THE CLAIMS section to overcome this rejection and the newly added portion is disclosed in the specification on page 5, lines 1-21 and Fig.3. No new matter is introduced.

Second, the Applicant intends to point out the difference between the amended claim 1 of the present application and Matsuyama's disclosure. The amended claim 1 of the present application is repeated below:

1. (Currently amended) A liquid crystal display (LCD) comprising:
 - a first substrate comprising a first surface;
 - 5 a second substrate comprising a second surface, the second surface being in parallel with and opposite to the first surface of the first substrate, and a pixel area being defined on the second surface;
- 10 a first common electrode positioned on the first surface of the first substrate;
a pixel electrode disposed above the pixel region of the second substrate, the second electrode having a first slit elongated along a first direction;
- 15 an isolation layer disposed on the surface of the second substrate to cover the pixel electrode;
a second common electrode disposed on the isolation layer and within the pixel region, a second slit being defined on the second common electrode and along the first direction, the first and second slits being interlaced;
- 20 and
a plurality of anisotropic liquid crystal molecules with negative dielectric constant positioned between the first common electrode and the second common electrode, the longitudinal axis of the liquid crystal molecules

being positioned along a second direction horizontally,
and a first angle being formed between the first
direction and the second direction;
wherein a biased electric field is formed as a voltage is
5 applied between the first common electrode and the pixel
electrode,
such that (a) a first horizontal biased electric field
is formed in the neighborhood of the second slit,
the first horizontal biased electric field is
10 perpendicular to the first direction, and the
liquid crystal molecules are rotated to make the
longitudinal axis of the liquid crystal molecules
in the neighborhood of the second slit being in
parallel to the first direction,
15 (b) the longitudinal axis of the liquid crystal
molecules in the neighborhood of the first common
electrode maintain along the second direction
because no horizontal biased electrical field is
formed near the first common electrode, and
20 (c) the liquid crystal molecules between the first
common electrode and the second slit of the second
common electrode gradually rotate from the second
direction to the first direction.
25 As disclosed in the amended claim 1 of the present

application, there is one obvious difference between Matsuyama's invention and the present application. According to Matsuyama's invention, the second common electrode is positioned on the bottom surface of the top substrate, the first common electrode is positioned on the top surface of the bottom substrate, and the pixel electrode is positioned on the first common electrode and is isolated from the first common electrode by an isolation layer. In the present application, the upper common electrode is positioned on the bottom surface of the top substrate, the pixel electrode is positioned on the top surface of the bottom substrate, and the lower common electrode is positioned on the pixel electrode and is isolated from the pixel electrode by an isolation layer.

Furthermore, according to the arrangement of electrodes in the present application, the isolation layer 206 is not only used to isolate the lower common electrode 210 from the pixel electrode 208, but is also used to avoid short circuits between the pixel electrode 208 and the upper electrode 104 (page 7, lines 32-34). In other words, the isolation layer of the present application can prevent electrodes from short-circuiting, thus eliminating problems of bright spots on a LCD (page 8, line 37 to page 9, line 2). Matsuyama never teaches how to avoid such a phenomenon according to the electrode arrangements in his invention.

From the above discussion, the Applicant believes that the amended claim 1 of the present application is absolutely different from Matsuyama's disclosure. Reconsideration of the rejection over the amended claim 1 is hereby requested.

As claims 2,5 and 6 are dependent upon claim 1, they should be allowed if the amended claim 1 is allowed. Reconsideration of claims 2,5 and 6 is therefore requested.

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2. Rejection of Claims 3 and 4 under 35 U.S.C. 103(a):

As to claims 3 and 4 Matsuyama discloses the liquid crystal display of claim 1 wherein the second electrode, 410, is a transparent common electrode (Applicant's pixel electrode)(col.15, lines 14-17 and col.21, lines 42-45) and wherein the third electrode, 300, is a transparent pixel electrode (Applicant's lower common electrode).

However, Matsuyama does not explicitly disclose a display wherein the second electrode, 410, is a pixel electrode and wherein the third electrode, 300, is a lower common electrode.

Sato teaches in his first embodiment (Figures 7 and 8) a TFT substrate that has the pixel electrode above the common electrode with a bottom gate TFT (col.8, lines 63-65) is functionally equivalent (col.12, lines 7-11) to his second embodiment (Figures 10 and 11) a TFT substrate that has the common electrode above the pixel electrode with a top gate TFT (col.11, lines 59-61). Furthermore, reversal of parts is considered an obvious expedient, MPEP 2144.04, VI, A.

Sato is evidence that ordinary workers in the art of liquid crystals would find the reason, suggestion, or motivation to use a pixel electrode below a common electrode as an art recognized equivalent, MPEP 2144.06.

Therefore, it would have been obvious to one having

ordinary skill in the art of liquid crystals at the time the invention was made to modify the LCD of Matsuyama with the art recognized equivalent of Sato.

5 **Response:**

As disclosed in Sato's invention, the term "functionally equivalent" merely indicates to balance the flexo-electric effects found above the first comb-shape electrode and the second comb-shape, 10 respectively (col.11, lines 1-6). That means, the dielectric distance between the upper surface of the first comb-shaped electrode and the liquid crystal layer is the same as the dielectric distance between the upper surface of the second comb-shaped electrode 15 and the liquid crystal layer, by compensating with the flexo-electric relieving layer 103 composed of an insulating film. Therefore, the radial configuration of liquid crystal above the first comb-shaped electrode is identical with that above the second 20 comb-shaped electrode to balance polarization of liquid crystal. If electric charges are accumulated on the first and second comb-shaped electrodes to the same degree, a voltage based on a direct current is not residual across the first and second comb-shaped 25 electrodes to avoid the generation of after-image, even after in-plane switching has been stopped.

Sato never teaches how to functionally equivalent his first preferred embodiment and his second 30 preferred embodiment in terms of field effect. The electric fields, as shown in Fig.1 and Fig.2, resulting from the electrode arrangement in the first preferred embodiment

of Sato's invention are absolutely different from the electric fields, as shown in Fig.3 and Fig.4, resulting from the electrode arrangement in the second preferred embodiment of Sato's invention based on a floating top substrate. In Fig.1, 5 the electric field line starts from one of the pixel electrodes and points to the adjacent lower common electrode, making many circular equipotential lines surrounding the pixel electrode. In Fig.2, the electric field line starts from one of the lower common electrode and points to the adjacent pixel electrode 10 to result in many circular equipotential lines surrounding the pixel electrode too. In Fig.3, the electric field line starts from one of the pixel electrode and points to the adjacent lower common electrode, making equipotential lines nearby the pixel electrode in a wave and many circular 15 equipotential lines surrounding the lower common electrode. In Fig.4, the electric field line starts from one of the lower common electrodes and points to the adjacent pixel electrode, making equipotential lines nearby the pixel electrode in a wave and many circular equipotential lines surrounding the lower common electrode. 20 Therefore, the directions of electric fields and equipotential line distributions in the first preferred embodiment and the second preferred embodiment of Sato's invention are different from each other.

25 When combining Sato's invention with Matsuyama's invention, the device having the upper common electrode on the bottom surface of the top substrate and the pixel electrode above the lower common electrode are obviously different from the present application 30 device. As shown in Fig.5A and Fig.6A, since there is no flexo-electric relieving layer disposed above the pixel electrode in Fig.5A and no flexo-electric

re lieving layer disposed above the lower common electrode in Fig.6A, the dielectric distance between the upper surface of the pixel electrode and the liquid crystal layer is different from the dielectric distance between the upper surface of the lower common electrode and the liquid crystal layer in both cases. Therefore, the radial configuration of liquid crystal above the pixel electrode and the lower common electrode in Fig.5A is different from that above the pixel electrode and the lower common electrode in Fig.6A because they are not compensated with the flexo-electric relieving layer. As shown in Fig.5A and Fig.6A, the equipotential lines of the LCD device, formed by combining the disclosures of Sato's and Matsuyama's (shown in Fig.5A), distribute more close to the upper common electrode than the equipotential lines of the present application LCD device (shown in Fig.6A). Similarly, the equipotential lines of the LCD device, formed by combining the disclosures of Sato's and Matsuyama's (shown in Fig.7A), distribute more close to the upper common electrode than the equipotential lines of the present application LCD device (shown in Fig.8A).

In summary, the electric field distributions and equipotential line distributions shown in Fig.5B-8B are different from each other. The liquid crystal display having the pixel electrode above the lower common electrode can never produce the same electric field as the liquid crystal display having the lower common electrode above the pixel electrode. As a result, the liquid crystal molecules on top of the pixel electrodes are rotated due to absolutely different electric field

distributions and absolutely different potential distributions, not only in density and strength but also in direction. Finally, the rotation situations of the liquid crystal molecules are totally different
5 and result in different display performance.

Furthermore, the LCD device taught in the present application is embedded with anti-static charges function because the static charges accumulated on the
10 upper common electrode can be released when the upper common electrode is in contact with the lower common electrode. However, since the LCD device disclosed in Sato's invention does not have an upper common electrode disposed on the bottom surface of the top
15 substrate, the LCD device is very sensitive to changes of environment. In other words, the LCD device is very easily to be interfered with factors, such as static charges, external electrical field, etc. Therefore, it is necessary to coat a conductive layer on the top
20 surface of the top substrate of Sato's LCD device to conduct static charges. Even though the LCD device of Matsuyama is modified with the art recognized equivalent of Sato (to dispose the pixel electrode on the top surface of the bottom electrode, and to
25 position the first common electrode on the pixel electrode and isolate it from the pixel electrode by an isolation layer), the anti-static charges function is not embedded. As a result, the conductive layer for releasing the static charges accumulated on the upper common
30 electrode still need to be coated in the LCD device of Matsuyama after being modified with the art recognized equivalent of Sato.

In addition to the static charges vulnerable property, an unexpected short caused by particles existing between the top substrate and the bottom substrate is more likely to occur in the LCD device taught by Sato. In the present application, since the upper common electrode is immediately above the lower common electrode, such unexpected short phenomenon is prevented.

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From the above discussion, the Applicant believes that claims 3 and 4 of the present application is absolutely different from the combination of Matsuyama's disclosure and Sato's disclosure.

15 Reconsideration of the rejection over claims 3 and 4 is hereby requested.

3. Rejection of Claims 7-11 under 35 U.S.C. 103(a):

As to claims 7,8 and 11, Matsuyama discloses the liquid crystal display of claim 1.

Matsuyama does not explicitly disclose the use of a conductive protrusion.

Tani teaches as prior art the use of a conductive columnar spacer (Applicant's protrusion) projected from the first surface of the first substrate, the protrusion being electrically connecting the counter electrode (Applicant's first electrode) with the auxiliary line so that the first electrode and the auxiliary line are held at substantially equal voltage. Since the voltage is applied from a large number of locations to the counter electrode, the resistance between the auxiliary line and the counter electrode

is so small that the voltage at the counter electrode can be surely maintained at a predetermined value (Applicant's reduce signal delay). Also, since no stress is generated, irregular display may not occur,
5 thus improving the display quality, Further, the data bus lines and the scan bus lines may not be disconnected (col.1, lines 40-57).

Tani is evidence that ordinary workers in the art of liquid crystals would find the reason, suggestion,
10 or motivation to add conductive protrusions to electrically connect a first electrode on a first substrate to conductive elements of like potential on the opposed substrate so the counter electrode can be surely maintained at a predetermined value, so, an
15 irregular display may not occur, thus improving the display quality.

Therefore, it would have been obvious to one having ordinary skill in the art of liquid crystals at the time the invention was made to modify the LCD of Matsuyama with the conductive protrusions of Tani to electrically connect a first electrode on a first substrate to a third electrode of like potential on the opposed substrate so the counter electrode can be surely maintained at a predetermined value so, an
25 irregular display may not occur, thus improving the display quality.

As to claim 9, Matsuyama discloses a display wherein the third electrode has a width, and the width is reduced by opening portions, 304 (Applicant's second slit), so as to increase an aperture ratio of the display.
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As to claim 10, the recitations of: wherein static

charges formed on the first electrode are released through the protrusion after the first electrode is connected to the third electrode, is a performance recitation in a device claim that is considered 5 inherently met by the structure of Matsuyama in view of Tani.

Response:

The conductive protrusions, shaped in a ball, in 10 Tani's invention are only disposed in the circumference of the liquid crystal panel (refer to column 3, lines 55-60). In the present application, a plurality of protrusions are formed on the first surface of the first substrate, and the first electrode 15 is disposed above the first substrate and cover these protrusions (refer to Page 8, lines 5-8 and Fig. 6). That means, the conductive protrusions according to the present application are disposed between the upper common electrode and some/all of the lower common 20 electrodes to connect the upper common electrode immediately above the lower common electrodes with some/all of the lower common electrode. Actually, the lower common electrodes do not exist in the circumference of the liquid crystal panel, rather, in 25 the pixel array area. Therefore, the conductive protrusions in the present application are disposed within the liquid crystal panel extensively and evenly.

30 Moreover, when applying Tani's conductive protrusions to the liquid crystal panel, the RC delay can never be effectively reduced because the

resistance value of the overall equivalent resistor between the counter electrode and the transfer electrode cannot be lowered. As a result, the application of the conductive protrusions according 5 to Tani's invention is limited to small sized liquid crystal panels. In contrast to Tani's conductive protrusions, the conductive protrusions according to the present application are disposed between the upper common electrode and the lower common electrode 10 because the upper common electrode is immediately above the lower common electrode. Under these circumstances, the conductive protrusions in the present application are disposed within the liquid crystal panel extensively and evenly.

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By applying the present application conductive protrusions to the liquid crystal display panel extensively and evenly, a much lower resistance value of the overall equivalent resistor between the upper 20 common electrode and the lower common electrode is resulted, which decreases the RC delay greatly to stabilize the potential on the common electrodes. As a result, the conductive protrusion in the present application can be applied to large sized liquid crystal display panels, 25 medium sized liquid crystal display panels, and small sized liquid crystal display panels. Furthermore, ripples of the display image and light leakage problem caused by ball shape spacers can be eliminated by adapting the present application protrusions to adjust 30 a cell gap between the top substrate and the bottom substrate. Reconsideration of the rejection over claims 7-11 is hereby requested.

4. Response to Arguments:

Applicant's arguments filed on 26 February 2003 have been fully considered but are not persuasive.

5 Applicant's ONLY arguments are as follows:

(1) Regarding claims 1,2,5, and 6, the instant Application is absolutely different in that *inter alia* the pixel electrode is on the top surface of the bottom substrate in contrast to the Matsuyama pixel electrode on the isolation layer that is 10 in-turn on the first common electrode.

(2) Regarding claims 1,2,5, and 6, Matsuyama never teaches how to avoid short-circuiting.

15 (3) Regarding claims 3 and 4, a display with a pixel electrode above the common electrode can never produce the same electric field as a display with the common electrode above the pixel electrode.

(4) Regarding claims 7-11, Tani does not teach the use of conductive protrusions extensively and evenly.

20 Examiner's responses to Applicant's ONLY arguments are as follows:

(1) It is respectfully pointed out that Applicant did not claim a pixel electrode in claims 1,2,5, and 6; Applicant broadly claims a second electrode.

25 (2) It is respectfully pointed out that Matsuyama discloses the claimed structure, and does not need to teach all beneficial effects inherent to said structure.

30 (3) It is respectfully pointed out that Sato teaches that electrodes may reversed in a display. *Also, liquid crystal displays often use alternating current*, so the electric field produced is likewise alternating. Sato is evidence that reversing or interchanging the pixel electrode and the lower

common electrode would have been obvious to those having ordinary skill in the art of liquid crystals at the time the claimed invention was made as an art-recognized species suitable for the intended purpose of comprising switching electrodes (MPEP 2144.07).

(4) It is respectfully pointed out that Tani is evidence that ordinary workers in the art of liquid crystals would find the reason, suggestion, or motivation to add conductive protrusions to electrically connect a first electrode on a first substrate to conductive elements of like potential on the opposed substrate so the counter electrode can be surely maintained at a predetermined value, so, an irregular display may not occur, thus improving the display quality, per rejection above. Examiner maintains the teaching of Tani would have rendered Applicant's claimed invention obvious those having ordinary skill in the art of liquid crystals at the time the claimed invention was made. Additionally, it is respectfully pointed out that Applicant did not claim the use of conductive protrusions extensively and evenly in claims 7-11; Applicant broadly claims a protrusion.

Response:

The terms "second electrode" in claims 1,2,5, and 6 are changed to "pixel electrode" in the above AMENDMENTS TO THE CLAIMS section to overcome this rejection and the newly added portion is disclosed in the specification on page 5, lines 1-21 and Fig.3. No new matter is introduced.

Sato teaches that electrodes may be reversed in a display based on no flexo-electric effects existing. As narrating previously, the electric field

distributions and equipotential line distributions shown in Fig.5B-8B are different from each other. Therefore, no matter a positive voltage or a negative voltage is applied to the pixel electrode of the 5 present application LCD device, the electric field produced is absolutely different from those produced when the same positive voltage and the same negative voltage are applied to the LCD device, formed by combining the disclosures of Sato's and Matsuyama's.

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The conductive protrusions according to the present application are disposed between the upper common electrode and some/all of the lower common electrodes to connect the upper common electrode immediately above the lower common 15 electrodes with some/all of the lower common electrode. Therefore, the conductive protrusions in the present application are disposed within the liquid crystal panel extensively and evenly in the pixel array area. Tani never teaches how to dispose conductive protrusions in a liquid 20 crystal display to reduce a delay of the common signal, increase an aperture ratio of the display, release static charges, and speed up the rotation of the liquid crystal displays.

25

5 Sincerely yours,

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